REMARKS

Claims 1-32 are pending in this application. Claims 15-16, 18-19 and 28-32 have been withdrawn from consideration. Claims 1-14, 17, and 20-27 have been rejected. Claims 1, 5-6, 17, 20, and 25 have been amended. Claims 2-4, 7, and 13-14 have been canceled without prejudice.

The application has been restricted to Group I corresponding to claims 1-4, 17, and 20-27, and Group II corresponding to claims 15-16, 18-19, and 28-32. Applicant affirms the election of Group I, claims 1-14, 17, and 20-27 made without traverse during the telephone conversation on July 8, 2002.

Claim 26 has been rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. This rejection is respectfully traversed.

It is asserted in the Office Action that there could be just one light-emitting element in claim 26 and thus "it is not understood how different wavelengths could be emitted." Claim 26 recites "at least one light-emitting element formed on each of two surfaces of said photonics crystal layer." Because at least one light-emitting element is formed on each of two surfaces, the semiconductor light-emitting element of claim 26 includes at least two light-emitting elements, and thus the at least two light-emitting elements may emit light with different emission wavelengths. Therefore, it is respectfully submitted that claim 26 is not indefinite, and withdrawal of the rejection is respectfully requested.

Claims 1-2 and 9-12 have been rejected under 35. U.S.C. §102(b) as being anticipated by *Schetzina* (U.S. Patent No. 5,351,255).

Claim 2 has been canceled without prejudice.

Claim 1 has been amended to recite in pertinent part "an intermediate layer formed on said electrode of the one conductivity type, containing at least one of In, Ag, Ni and Cr." Support for the intermediate layer is found in the specification as the layer 3120. The intermediate layer containing at least one of In, Ag, Ni and Cr may reduce the thermal strain of the active layer and improve reliability. (Application, p. 17, lns. 26-32.)

As understood, *Schetzina* at best merely discloses a substrate 103 having a metal electrode 104 disposed thereon. (Col. 19, lns. 3-17, Fig. 26B.) The bonding layer 106 is formed

between the electrode 104 and an ohmic metal electrode 13. The bonding layer 106 may be formed of conducting epoxy or solder. (Col. 19, lns. 12-15.) The bonding layer 106 of *Schetzina* is not the "intermediate layer formed on said electrode of the one conductivity type, containing at least one of In, Ag, Ni and Cr" recited in amended claim 1.

Further, the bonding layer 106 of *Schetzina* cannot reduce the thermal strain of the active layer as does the intermediate layer recited in amended claim 1. A bonding layer 106 formed of conducting epoxy has a high thermal resistance, and thus cannot reduce the thermal strain of the active layers 11 and 12. Furthermore, if the bonding layer 106 is formed of conducting solder, the layer 106 is stiff and forms crystal defects in other layers of the light emitting element when the bonding layer 106 cures. Consequently, the bonding layer 106 deteriorates the light-emitting element.

Lacking at least this claimed feature, *Schetzina* cannot render amended claim 1 unpatentable. Because claims 9-12 depend on claim 1, for similar reasons *Schetzina* cannot render claims 9-12 unpatentable. Therefore, it is respectfully submitted that claims 1 and 9-12 are patentable over the references of record.

Claims 3-8 and 13 have been rejected under 35 U.S.C. §103(a) as being unpatentable over *Schetzina* in view of *Biing-Jye et al.* (U.S. Patent No. 6,169,294).

Claims 3-4, 7 and 13 have been cancelled without prejudice.

Claim 5 has been amended to depend on claim 1, and to further recite a "contact layer of the one conductivity type and a strain relaxing layer, formed between said reflective layer and said light-emitting layer."

Claim 6 has been amended to depend on claim 1 and to further recite "a contact layer of an opposite conductivity type formed between said light-emitting layer and said transport electrode, containing InGaP or InGaAlP."

Amended claims 5 and 6 and claim 8 depend on amended claim 1.

Schetzina is described above. *Biing-Jye et al.* does not disclose the intermediate layer recited in amended claim 1. *Biing-Jye et al.* has been cited for disclosing "a light-emitting device having an n-GaN contact layer between the light-emitting layer and the n-type electrode" as shown in Figure 3. An insulating layer SiO_2 is formed on the substrate N-Si. A metal contact is formed on the insulation layer, with a solder #2 layer on the metal contact. A p-ohmic layer is formed on the solder #2 layer with a p-GaN contact layer on the p-ohmic layer as shown in

Figure 3. However, none of these layers are the intermediate layer recited in amended claim 1. Neither *Schetzina* nor *Biing-Jye et al.* disclose or even suggest, individually or in combination, the intermediate layer recited in amended claim 1, and thus do not render claims 5-6 and 8, which depend on claim 1, unpatentable.

Therefore, it is respectfully that claims 5-6 and 8 are patentable over the references of record.

Claims 14 and 25 have been rejected under 35 U.S.C. §103(a) as being unpatentable over *Schetzina* in view of *Takeuchi et al.* (U.S. Patent No. 5,225,692).

Claim 14 has been cancelled without prejudice.

Claim 25 has been amended to recite "a photonics crystal layer fused on another surface of said semiconductor substrate." The photonics crystal layer has support in the specification as shown in the embodiment of Figures 22A-22D. As indicated by the arrows in Figure 22D, light emitted downward by the light-emitting layer is reflected by the photonics crystal layer, and light emitted toward the edge of the substrate is reflected at the rounded edge of the substrate. Therefore, the light extraction efficiency is improved.

Schetzina is described above. *Takeuchi et al.* has been cited for disclosing an LED having a window 10A, which has a rounded edge as shown in Figure 4. *Takeuchi et al.* does not disclose a photonics crystal layer. More particularly, *Takeuchi et al.* does not disclose or even suggest a photonics crystal layer fused on a surface of a semiconductor substrate having a rounded edge as recited in amended claim 25. Lacking a disclosure or a suggestion of at least this claimed feature, neither *Schetzina* nor *Takeuchi et al.*, individually or in combination, disclose or even suggest the photonics crystal layer as recited in amended claim 25, and thus cannot render amended claim 25 unpatentable. Therefore, it is respectfully submitted that claim 25 is patentable over the references of record.

Claim 17 has been rejected under 35 U.S.C. §103(a) as being unpatentable over *Schetzina* modified by *Biing-Jye et al.*, and further in view of *Takahashi et al.* (U.S. Patent No. 5,360,762).

Claim 17 has been amended to further recite "a light-reflecting electrode formed on the recessed surface of said contact layer." The light-reflecting electrode is supported in the specification by the electrode 307 formed on the layer 305 of the embodiment shown in Figure 13, and described on page 21, lines 8-20. The light-reflecting electrode formed in the recessed

surface reflects light emitted by the double-heterostructure for extraction outside from a side surface of the element. This improves the light extraction efficiency.

Schetzina and *Biing-Jye et al.* are described above. *Takahashi et al.* at best merely discloses a cap layer 42 having a recess as shown in Figure 6(d). Because *Takahashi et al.* discloses a laser device, the recess is not formed to improve light extraction efficiency, but rather to improve the light confinement efficiency. Therefore, *Takahashi et al.* does not teach the "light-reflecting electrode formed on the recessed surface of said contact layer" as recited in claim 17, which contributes to the improved light extraction efficiency.

Neither *Schetzina*, *Biing-Jye et al.*, nor *Takahashi et al.* disclose or even suggest, individually or in combination, the light-reflecting electrode recited in claim 17, and thus these references cannot render claim 17 unpatentable. Therefore, it is respectfully submitted that claim 17 is patentable over the references of record.

Claim 20 has been rejected under 35 U.S.C. §103(a) as being unpatentable over *Schetzina* in view of *Bour et al.* (U.S. Patent No. 5,977,612).

Claim 20 has been amended to recite a semiconductor light-emitting diode. Support for claim 20 is shown in Figures 15 and 16 and the corresponding description in the specification. A laser diode is not included in the scope of claim 20.

Schetzina is described above. As understood, *Bour et al.* at best discloses a laser diode as shown in Figures 2(a) and 2(b) and described at column 6, lines 41-49. The upper distributed Bragg reflector (DBR) layer 114 allows the transmission of light for the laser. (Column 5, lines 28-31). Thus, *Bour et al.* discloses a laser diode that extracts light from only the top surface, and does not extract light from the end surface. This is not a light-emitting diode as recited in amended claim 20. The light-emitting diode of claim 20 can extract light from the end surface to improve light extraction efficiency.

Neither *Schetzina* nor *Bour et al.* disclose or even suggest, individually or in combination, the light-emitting diode comprising a light emitting layer having a shape that is a polygonal prism having at least five corners or a circular cylinder as recited in amended claim 20. Therefore, it is respectfully submitted that amended claim 20 is patentable over the references of record.

Claims 21-23 and 26-27 have been rejected under 35 U.S.C. §103(a) as being unpatentable over *Schetzina* in view of *Suzuki et al.* (U.S. Patent No. 5,253,264). This rejection is respectfully traversed.

Claims 21-23 and 26-27 each recite a light-emitting element comprising a photonics crystal layer.

Schetzina is described above. As understood, *Suzuki et al.* at best merely discloses an integrated LED device having a differential grating formed on a layer 3B of a multiple quantum well. The quantum well 3B is asserted to be a photonics crystal layer.

However, a diffraction grating is not a photonics crystal layer. As described on page 24, lines 24-35 of the patent application, photonics crystals have a periodic gradient index in a medium, and photonics crystals have two-dimensional and three-dimensional structures in general to enhance the effect.

A gradient constant of photonics crystals is about a half wavelength of light, and a photon severely interferes with the periodic gradient structure. The extent of interference depends on a grading constant, dielectric constant, and a grating structure.

A photonics crystal has a bandgap. No optical state exists in the bandgap, and thus light having photon energy corresponding to the bandgap does not exist in the crystals.

In contrast, a diffraction grating in the laser of *Suzuki et al.* has only a one-dimensional periodic gradient index. Therefore, the diffraction grating cannot confine light in a two-dimensional or three-dimensional state. Furthermore, light propagates along the diffraction grating, but light cannot be extracted from the side of the diffraction grating or cannot be reflected on the diffraction grating. As a result, *Suzuki et al.* does not disclose photonics crystals, and the grating does not improve the light extraction efficiency. Therefore, *Suzuki et al.* does not disclose or even suggest the photonics crystal layer recited in claims 21-23 and 26-27. As noted in the Office Action, *Schetzina* also does not disclose a photonics crystal layer. Thus, neither *Schetzina* nor *Suzuki et al.* disclose or even suggest, individually or in combination, the photonics crystal layer recited in claims 21-23 and 26-27, and therefore cannot render claims 21-23 and 26-27 unpatentable. Therefore, it is respectfully submitted that claims 21-23 and 26-27 are patentable over the references of record.

Claim 24 has been rejected under 35 U.S.C. §103(a) as being unpatentable over *Schetzina* in view of *Paoli et al.* (U.S. Patent No. 5,138,625). This rejection is respectfully traversed.

Schetzina is described above. As understood, *Paoli et al.* at best merely discloses a laser having active quantum wires 288 formed on grooves 278 as shown in Figure 12. The grooves 278 are not formed to reflect light emitted from the active quantum wires 288, but are used to form the wires 288. (Column 12, lines 1-15). Thus, light is extracted from a certain limited face, because it has a general layer structure. However, the laser of *Paoli et al.* cannot improve the light extraction efficiency.

The wires 288 is not the "interface of said contact layer in contact with said first cladding layer is corrugated to have a gradient index" as recited in claim 24.

Lacking at least these claimed features, neither *Schetzina* nor *Paoli et al.*, individual or in combination, can render claim 24 unpatentable. Therefore, it is respectfully submitted that claim 24 is patentable over the cited references.

It is submitted that claims 1, 5-6, 8-12, 17, 20 and 21-27 are allowable, and allowance and issuance of this application is respectfully requested.

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Attached hereto is a marked up version of the changes made to the specification and claims by the current amendment. The attached page is captioned APPENDIX – MARKINGS TO SHOW CHANGES MADE.

Attorney Docket No. 2102401-900900

Please charge any additional fees, including any fees necessary for extensions of time, or credit overpayment to Deposit Account No. **07-1896, referencing 2102401-900900.**

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APPENDIX – MARKINGS TO SHOW CHANGES MADE

1. (amended) A semiconductor light-emitting element comprising:

a substrate;

an electrode of one conductivity type which is formed on said substrate;

an intermediate layer formed on said electrode of the one conductivity type, containing at least one of In, Ag, Ni and Cr;

a reflective layer which is formed on said [substrate] intermediate layer, contains a metal, and reflects a light;

a light-emitting layer formed on said reflective layer to emit light, having a double-heterostructure in which an active layer is sandwiched between first and second cladding layers; and

a transparent electrode formed on said light-emitting layer to transmit light.

5. (amended) An element according to claim [4] 1, further comprising a contact layer of the one conductivity type and a strain relaxing layer [which is sandwiched between said contact layer of one conductivity type and said first cladding layer, and], formed between said reflective layer and said light-emitting layer, wherein said strain relaxing layer has a middle band gap between band gaps of said contact layer of the one conductivity type and said first cladding layer.

6. (amended) An element according to claim [3] 1, [wherein said contact layer of the one conductivity type and said contact layer of the opposite conductivity type] further comprising a contact layer of an opposite conductivity type formed between said light-emitting layer and said transparent electrode, containing InGaP or InGaAlP.

17. (amended) A semiconductor light-emitting element comprising:

a transparent semiconductor substrate;

a double-heterostructure which is formed on said semiconductor substrate and contains a light-emitting layer and first and second cladding layers that sandwich two surfaces of the light-emitting layer; [and]

a contact layer which is formed on said double-heterostructure and has a recessed surface; and

a light-reflecting electrode formed on the recessed surface of said contact layer.

20. (amended) A semiconductor light-emitting [element] diode comprising at least a light-emitting layer formed on a semiconductor substrate,

wherein a shape of said semiconductor light-emitting element is a polygonal prism having at least five corners or a circular cylinder.

25. (amended) A semiconductor light-emitting element comprising:

a semiconductor substrate; [and]

a light-emitting layer formed on one surface of said semiconductor substrate; and

a photonics crystal layer fused on another surface of said semiconductor substrate,

wherein the other surface of said semiconductor substrate has a rounded edge.